GB 13552 (2008) (English): Automotive V – ribbed belts

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National Standard
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GB 13552-XXXX
Replaces GB 13552-1998

Automotive V – ribbed belts

(ISO 9981: 1998 belt drives-pulleys and V-ribbed belts for the automotive industry-PK profile: Dimensions, NEQ

ISO 11749: 1995 Belt drive -V – ribbed belts for the automotive industry-fatigue test, NEQ)

Draft Standard for approval

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Standardisation Administration of the People's Republic of China (SAC)

Foreword

Article 4.2 of this Standard is mandatory, whilst the rest are recommended.

This Standard corresponds to ISO 9981:1998, "Belt drives-pulleys and V-ribbed belts for the automotive industry – PK profile: Dimensions, NEQ" and ISO 11749:1995, "Belt drive-V-ribbed belts for the automotive industry – Fatigue test, NEQ), the consistency degree of this Standard and ISO 9981:1998 and ISO11749:1995 is non-equivalent.

This Standard replaces GB 13552-1998, "Automotive V-ribbed belts".

The main differences between this Standard and ISO 9981:1998 and ISO 11749:1995 are:

- The measurement methods for limit deviation of effective length, the reference value of rib height, the rib angle, and the exposed height have been added in accordance with Standard JASO E109-1994, "Automotive V – ribbed belts" of Japanese Automobile Manufacturers Association;
- the transmission power of three-pulley fatigue testing machine, tension and fatigue life-span of belts have been added in accordance with JASO E109-1994;
- the tensile characteristics, low-temperature resistance characteristics and appearance qualities of belts have been added in accordance with JASO E109-1994;
- inspection, symbol, packaging, transport and storage rules have been added.

The main changes to this Standard compared to GB 13552 – 1998 are:

- the limit deviations of the effective length are more strictly regulated (Section 4.5.4 of Edition 1998, Section 3.5.4 of this Edition);
- specific requirements for fatigue testing equipment have been added, as well as test procedures and specific requirements for equipment of two-pulley testing machine (See A.2, A.4.2.1.2);
- the fatigue testing index of V-ribbed belts has been increased from 50 hours to 80 hours (Article 5.2 of Edition 1998, Article 4.2 of this Edition);
- the fatigue testing methods of V-ribbed belts have been moved from the main Section to Appendix A (Article 6.2 of Edition 1998, Appendix A to this Edition).

Appendix A to this Standard is a normative annex.

This Standard is proposed by China Petroleum and Chemical Industry Association.

This Standard is under the jurisdiction of the Technical Committee of Chemical Industry Rubber Belts for Standardisation.

The organisations that participated in the drafting of this Standard are:
Guizhou Dazhong Rubber Co., Ltd;
Hangzhou Jintai Belt Co., Ltd;
Zehjiang Zijingang Rubber Belt Co., Ltd;
Ningbo Fengmao Far-east Rubber Co., Ltd;
China Wuxi Belt Co., Ltd;
Northwestern Polytechnic University;
Qingdao Rubber Industry Research Institute.
The main draughters of this Standard: Xiang Xuewei, Song Huiyan, Wang Jinfang, Chen Hai, Zeng Jun, You Jianping, Li Shujun, Han Deshen, Deng Ping, Xu Zhe.

This standard replaces the previously issued Standards:
GB 13552-1992, GB 13552-1998.

Automotive V-ribbed belts

1 Scope

This Standard specifies the product categories, requirements, test methods, inspection rules, markings, packaging, storage and transport of automotive v-ribbed belts (hereinafter referred to as the belts).

This Standard applies to transmission belts for fans, motor, pumps, compressors, power steering pumps and superchargers etc. of internal combustion engines for automotives.

2 Normative References

The provisions of the following documents become provisions of this Standard after being referenced. For dated reference documents, all later amendments (excluding corrigenda) and versions do not apply to this Standard; however, the parties to the agreement are encouraged to study whether the latest versions of these documents are applicable. For undated reference documents, the latest versions apply to this Standard.

GB/T 11357 Quality, Surface-roughness and balance of transmission pulleys (GB/T 11357-1989, eqv ISO 254:1981)

GB/T 17516.2 V-and ribbed belt drives – Dynamic test to determine pitch zone location – Part 2: V-ribbed belts. (GB/T 17516.2, idt ISO 8370-2:1993)

3 Requirements of shapes, dimensions and raw materials

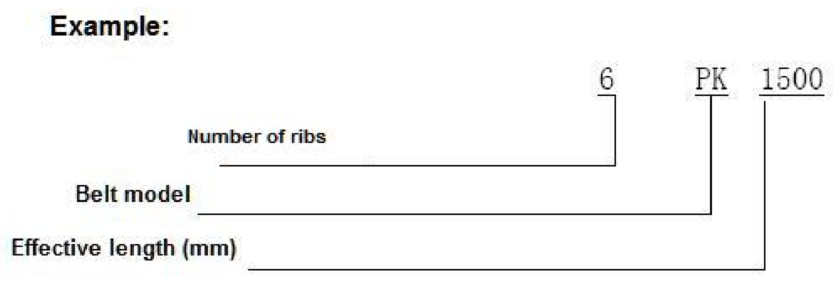
3.1 Model

The models of the belts are used to represent the section shapes and dimensions. The PK model is normally adopted for automotive v-ribbed belts.

3.2 Specifications, markings

The dimension characteristics of automotive v-ribbed belts include the number of ribs, model and effective length, and the belts are marked with the following numbers and letters:

a) the first group of numbers represents the number of ribs;
b) the group of letters represent the model;
c) the second group of numbers represents the effective length in millimetres.



3.3 Shapes and structures

Automotive v-ribbed belts are endless belts as shown in the section view in Figure 1.

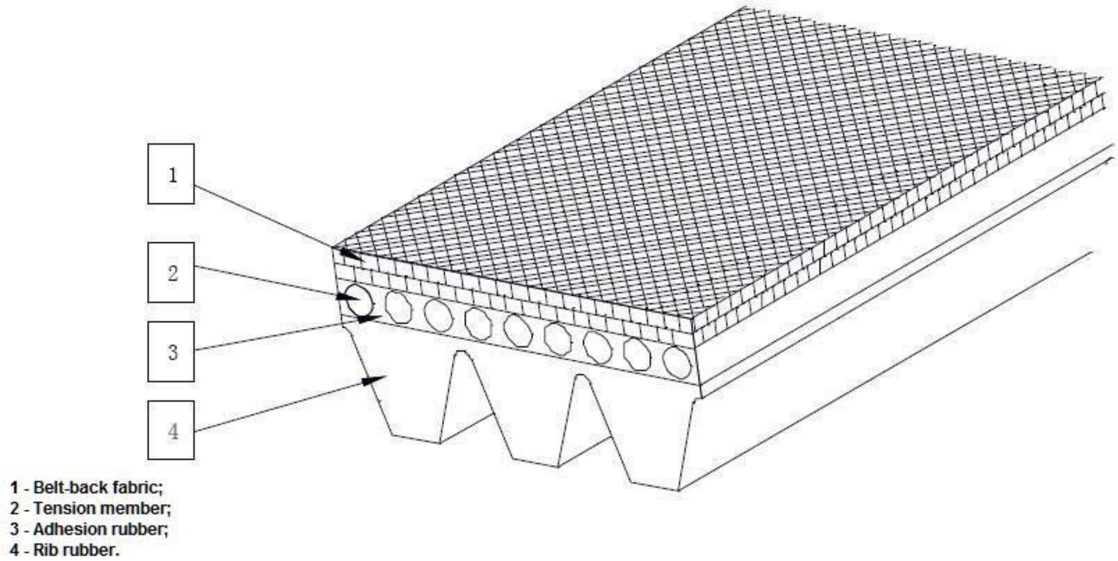


Figure 1 Structure of V-ribbed belt

3.4 Materials applied

3.4.1 Rubber

The constitution of the adhesion rubber and the rib rubber shall be uniform.

3.4.2 Belt-back fabric

Belt-back fabric is a textile woven from cotton fibres, synthetic fibres or a blend of the said fibres. The density of the warp-wise and weft-wise of the fabric shall be even, with no defects or twist deformations.

3.4.3 Tension member

Tension member is a cotton rope made of synthetic fibres; its yarn twists shall be uniform.

3.5 Dimensions

3.5.1 Section dimensions

The reference values for the section dimensions of the belts are shown in Figure 2 and Table 1.

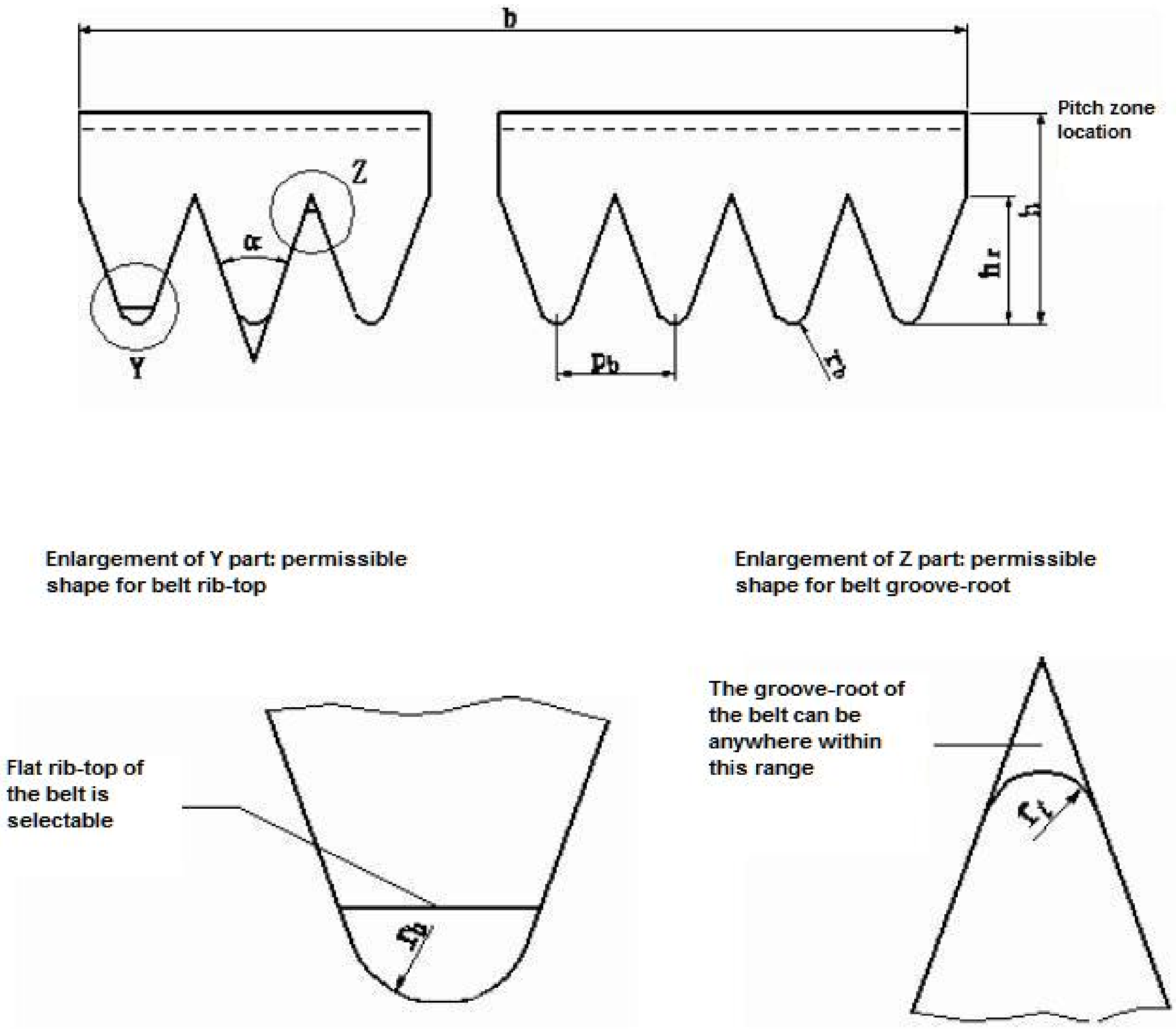


Figure 2 Section View of Belt

Table 1 Section dimensions of belt Unit: mm

Name	Dimension
Rib spacing P_b	3.56
Rib angle a	40^o
Arc radius of the rib-root r_t	0.25 (maximum)
Arc radius of the rib-top r_b	0.5 (minimum)
Belt thickness h	4 ~ 6 (reference)
Rib height h_t	2 ~3 (reference)
Note: the rib spacing and rib height as set out in the table are only reference values. The accumulated tolerance of rib spacing is an important index, but it is normally very often affected by the tension force when the belt is working and the modulus of the tension member.	

3.5.2 Effective line differential and exposed height

See Figure 3 for the effective line differential and the exposed height of the belt. The measurement of the exposed height shall be conducted in accordance with the method specified in 5.1; the measurement of the effective line differential shall be conducted in accordance with the method specified in GB/T 17516.2. The nominal value and the limit deviation of the exposed height and the effective line differential shall be decided through consultation between the supplier and buyer.

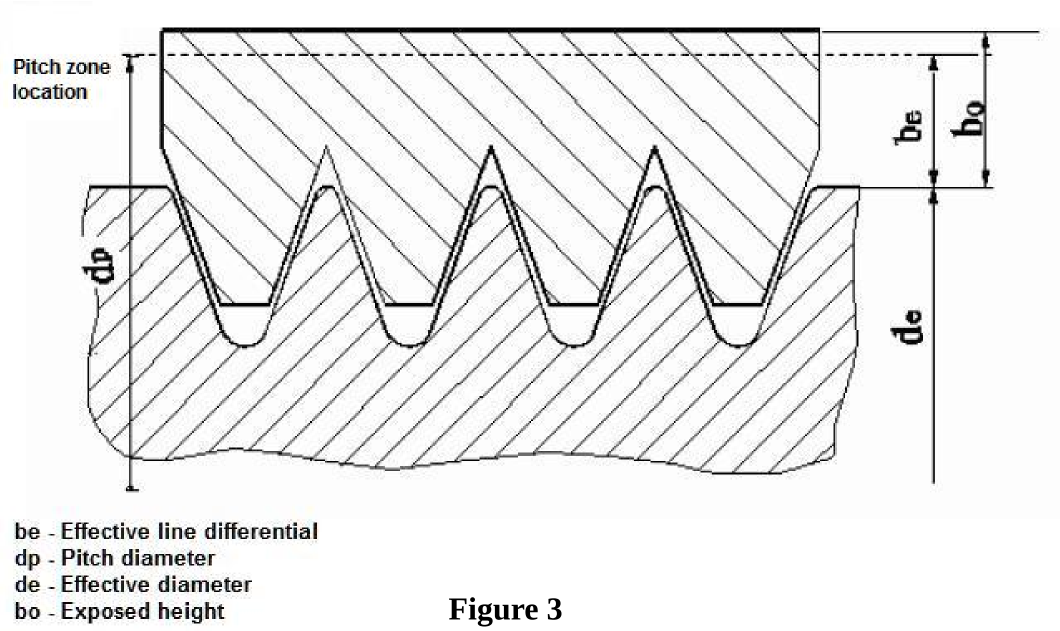


Figure 3

3.5.3 Minimum pulley diameter

In order to enable the belt to meet its specified service life, the diameter of the pulley selected shall not be smaller than the values set out in Table 2.

Table 2 Minimum pulley diameter **Unit: mm**

	Forward bending	Reverse bending
Effective diameter	55	-
External diameter	-	85

3.5.4 Limit deviation of effective length

The length of the belt is represented by effective length; its measurement is conducted in accordance with the method specified in 5.1. The effective length is usually an integral number of times of 10mm. See Table 3 for the limit deviation thereof.

Table 3 Limit deviation of effective length Unit: mm

Effective length L_e	Limit deviation
≤ 1000	± 5.0
> 1000, ≤ 1200	± 6.0
> 1200, ≤ 1500	± 8.0
> 1500, ≤ 2000	± 9.0
> 2000, ≤ 2500	± 10.0
> 2500, ≤ 3000	± 11.0
Note: when the effective length is greater than 3000mm, its limit deviation shall be decided by the agreement between the supplier and the buyer.	

4 Requirements

4.1 Appearance requirement

There shall be no harmful faults such as twisting, crookedness, cracking, bubbling or foreign articles etc. on the surface of the belt.

4.2 Fatigue life

According to the actual conditions of use of the belt or in accordance with the agreement between the supplier and the buyer, select a two-pulley, three-pulley or four-pulley bench testing machine to determine the fatigue life of the belt in accordance with the test method specified in Appendix A. When the test time reaches the prescribed test running time, there shall be no damage to the belt, as shown in Figure 4. The fatigue life of the belt shall not be shorter than 80 hours.

4.3 Tensile characteristics

The tensile characteristics of the belt shall be tested in accordance with the method specified in 5.3; its tensile strength and its elongation of reference tension shall conform to the requirements of Table 4.

Table 4 Tensile Characteristics

Number of ribs	Tensile strength kN	Elongation of reference tension %	Reference tension kN
3	≥ 2.40	≤ 3.0	0.75
4	≥ 3.20		1.00
5	≥ 4.00		1.25
6	≥ 4.80		1.50
More than 7	≥0.8 x n		0.25 x n
Note: n is the number of ribs.			

4.4 Low-temperature resistance characteristics

The low-temperature resistance characteristics of belts shall be tested in accordance with the method specified in 5.3; no cracks shall appear on the belts.

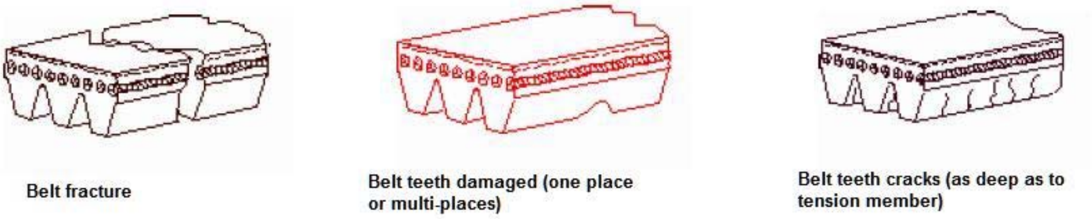


Figure 4

5 Test methods

5.1 Measurements of the length and exposed height

5.1.1 Equipment

The measurement of the effective length of the belt is conducted after wrapping the belt on the measuring equipment constructed with the following parts. Illustrated in Figure 5:

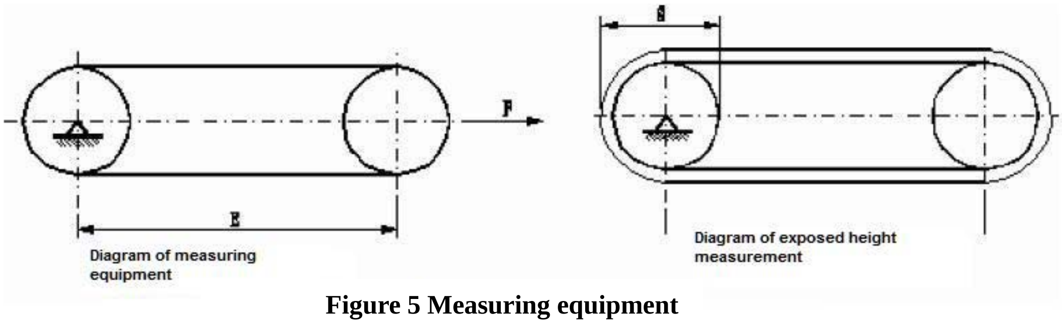


Figure 5 Measuring equipment of length and exposed height

5.1.1.1 Two of the same diameter pulleys, one is fixed and the other is movable. The pulley groove section and the section dimensions of the two pulleys shall conform to the requirements of Figure 6 and Table 5. The recommended applicable effective diameter may be determined by the magnitudes set out in Table 6.

5.1.1.2 Load applying device, used to apply total measuring load to the movable pulley.

5.1.1.3 Measuring device used to measure the distance between the centres of the two pulleys.

5.1.2 Measuring load

The measuring load applied, for the purpose to measure the effective length of the belt, shall conform to the requirements of Table 6.

5.1.3 Procedures

When measuring the effective length of a belt, rotate the belt for at least two rounds, enable the belt

ribs and the pulley grooves to be correctly matched, distribute the measuring load on the two straight sections of the belt evenly. Next, measure the distance E between the centres of the two pulleys; the effective length (L_e) of the belt and the exposed height (b_o) shall be determined by the following formula:

$$L_e = E_{max} + E_{min} + U_e$$

Where:

L_e - the effective length of the belt;

U_e – the effective circumference of the measuring pulley;

E_{max} – the maximum distance value between the centres of the two pulleys;

E_{min} – the minimum distance value between the centres of the two pulleys.

$$b_o = S - d_e$$

Where:

b_o – the exposed height, unit is mm;

d_e – the effective diameter of the pulleys, unit is mm;

S – Values used for calculation (see Figure 5), unit is mm.

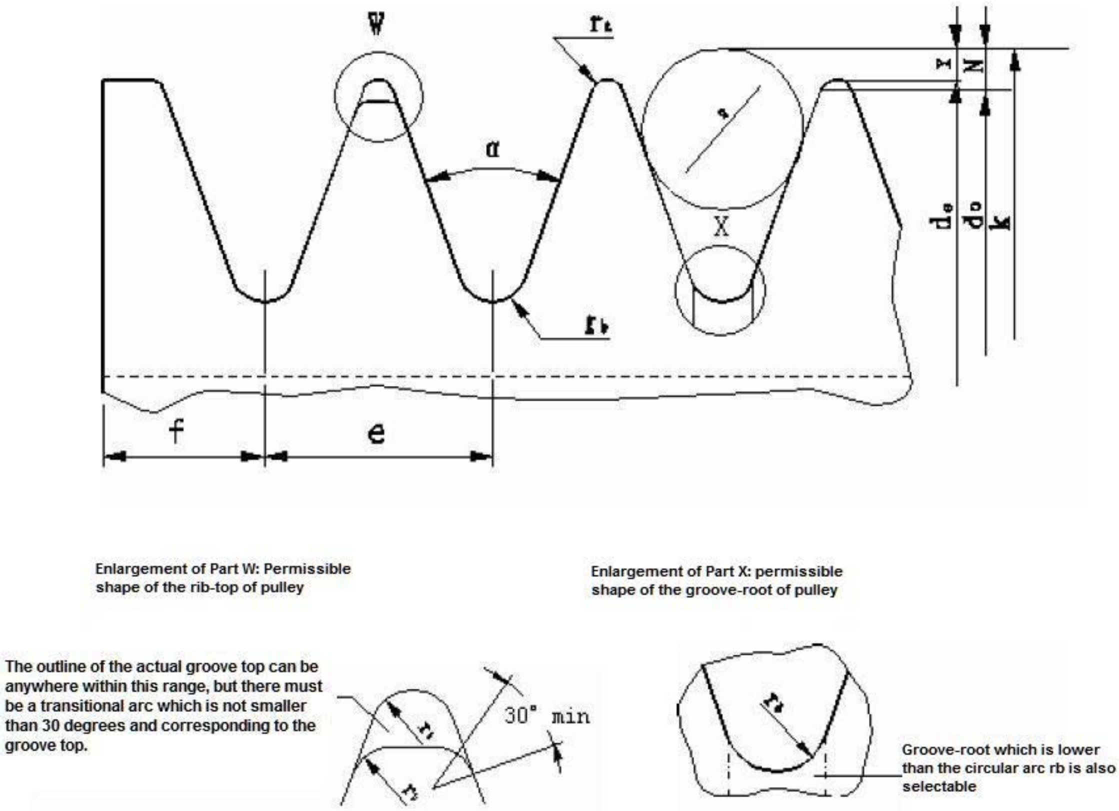


Figure 6 Section view of pulley groove

Table 5 Groove dimensions of PK type pulley   Unit: mm

Item	Limit deviation	Prescribed value
Groove pitch (e)	± 0.05[a,b]	3.56
Groove angle of measuring pulley (a^c)	± $0^o15'$	40^o
Groove angle of drive testing pulley and actual pulley (a^c)	± 1^o	40^o
r_t	Minimum value	0.25
r_b	Maximum value	0.5
Diameter of measuring ball (or column) d_B	± 0.01	2.5
2x	Nominal value	0.99
$2N^d$	Maximum value	1.68
f	Minimum value	2.5
a - the e tolerance value used to check the interval spacing between the axes of the two adjacent pulley grooves. b – the deviation sum of e value of any groove of any pulley shall not exceed ± 0.3. c – the angle between the centre line of the groove and the axis of the pulley shall be $90^o \pm 0.5^o$. Cdc – the N value is independent from the nominal diameter of the pulley; it is the radial distance from the contact point between the measuring ball (or column) inside the pulley groove and the groove to the outer margin of the measuring ball (or column).		

Table 6 Measuring pulley and measuring load

Item	Value
Effective circumference (U_e) of the measuring pulley (on the end point of the effective diameter)/mm	300
Pulley diameter at the outer margin of the ball (or column) k/mm	96.48 ± 0.13
Measuring load of each rib F/N	100

5.2 Tensile test

5.2.1 Samples

Cut out three sample pieces of a length of 250mm from one belt. In the middle of each sample draw two marking lines with a distance of 100mm between them, in order to determine the elongation. If

it is not possible to cut out three samples from the same belt, then the number of samples shall be decided through agreement between the manufacturer and the buyer.

5.2.2 Test procedures

In an ambient temperature of 25°C ± 5°C, perform the tensile test on the samples using a tensile testing machine. The test speed shall be 50mm/min ± 5mm/min. The maximum pulling force which makes the sample fracture shall be regarded as the tensile strength.

In general, the mean value of the three determined values after being rounded to two decimal places shall be taken as the standard determined value.

The value determined when a fracture occurs at the clamping location shall not be taken into account; the test shall be carried out on additional samples cut from the same belt in order to satisfy the determined value shortage.

5.3 Low temperature resistance test

5.3.1 Samples

Cut out three samples in accordance with the method specified in 5.2.1. Carry out pre-treatment for 70-72 hours in an ambient temperature of 100°C ± 2°C.

5.3.2 Procedures

Cool the samples to room temperature and leave them in an ambient temperature of -30°C± 1°C for 70 ~ 72 hours, then remove them out and carry out the bending test on a cylinder in accordance with Table 7. The bending angle shall be at least 90°.

Select the bending condition A2 or bending condition B2 in accordance with the state of the belts during use.

Table 7 Bending conditions

Item	Condition A2	Condition B2
Laboratory temperature, °C	25 ± 5	25 ± 5
Cylinder diameter, mm	40	70
Bending direction	Forward bending	Reverse bending
Note: if the rib part of the belt bends to medial side this shall be considered as forward bending; if the rib part of the belt bends to the lateral side shall be considered as reverse bending.		

5.4 Fatigue test

The fatigue test shall be performed on the belt in accordance with the provisions specified in Appendix A.

6 Inspection rules

6.1 Belts shall be checked and approved by the manufacturer's quality inspection department and issued with a quality certificate, after which they shall be ready to leave the factory.

6.2 Each belt shall be individually checked for appearance quality and effective length in accordance with 3.5.4 and 4.1.

6.3 One in every thousand belts shall be sampled for section dimensions measurement, and the tensile characteristics test shall be conducted at least twice per month.

6.4 The low temperature resistance test shall be conducted at least once every three months.

6.5 With regard to belts of same model that are made of the same materials, two sample belts shall undergo the fatigue life test, which shall be conducted at least once every six months.

6.6 If any item from the tests mentioned in 6.3, 6.4 and 6.5 fails, select double the quantity of samples from the same batch of belts and re-test the items that failed; if any item from the re-test fails again, then this batch of products shall be considered unqualified.

7 Symbols, tags, packaging, transport and storage

7.1 Symbols

A permanent clear visible symbol shall be placed on each belt, containing the following information:

a) specification mark;
b) manufacturer and trademark;
c) production date.

7.2 Tags and packaging

Each belt shall be packed within a paper bag or plastic film, and every 50 to 100 belts shall be packed within a packaging bag or box as appropriate. On the outside of each package the manufacturer, trademark, specification, quantity and production date shall be specified. A tag made of hardboard or plastic film shall be enclosed in the box, and shall contain the following information:

a) name of the manufacturer or trademark;
b) specification mark;
c) number of belts contained in the bag or box;
d) production date;
e) indication of the components code required by the buyer;
f) quality stamp of the quality inspection department.

7.3 Transportation, storage

7.3.1 During transportation or storage, direct exposure of the belts to sunlight, rain and snow should be avoided, as well as contact with other articles that could be harmful to the quality of the belt such as acid, alkali, oil and organic solvent etc. The belts should be kept clean. The storage location shall be at least one metre away from any heat source unit and during storage the belts should not be bent and squeezed.

7.3.2 During storage, the temperature of the store room shall be maintained within -15^{o}C- 40^{o}C. The relative humidity shall be within 50%-80%.

Appendix A

(Normative Annex)

Belt drives – Automotive industry V-ribbed belt – Fatigue test

A.1 Outline

Determine the transmission characteristics of the belt on a two-pulley, three-pulley or four-pulley testing machine as specified in A.2.1 in accordance with the following provisions.

Note 1: the length of the V-ribbed belts that can be tested on a four-pulley testing machine shall be at least 1,000 mm (see Figure A.1); V-ribbed belts of length within the range of 800 mm - 1,000 mm shall be tested on a three-pulley testing machine (see Figure A.2); belts which are shorter in length than abovementioned range shall be tested on a two-pulley testing machine (see Figure A.3). See Table A.1 for details.

Table A.1 Requirements of belt for transmission test

Test equipment	Belt rib numbers	Belt effective length/mm
Three-pulley testing machine	3	800 ~ 1000
Four-pulley testing machine	3	1000 ~ 1300

During testing, for certain test conditions such as transmission power and minimum permissible life-span of belts (use hour as unit), re-tension times shall be decided through agreement between the manufacturer and the buyer.

If a belt no longer meets the specified requirements, then it shall be considered to have lost its efficiency.

A.2 Equipment

A.2.1 Fatigue testing machine

The structure of the fatigue testing machine shall be stable and strong; all the components of the machine shall be able to bear the stresses caused during the test, and shall not be damaged.

The main components of a testing machine are (see Figure A.1 Figure A.2 and Figure A.3):

a) a drive pulley and suitable driving devices;
b) a driven pulley and a suitable power-absorbing device which is connected to the drive pulley;
c) the power-absorbing device shall be accurate and able to be corrected using an appropriate method (such as using weights);
d) a reverse bending tensioner pulley, only used on four-pulley testing machine (see Figure A.1);
e) a component which can directly bear the test tension load:

For three-pulley and four-pulley testing machines, this component shall be a tensioner pulley. (See Figure A.1 and Figure A.2);

For two-pulley testing machines, this component shall be a movable pulley (see Figure A.3);

f) for devices used for the measurement of the belt slippage the measurement precision shall be ± 1%.

See Figures A.1, A.2 and A.3 for an illustration of the arrangement and rotational direction of pulleys.

In order to enable the testing machines to be suitable for belts of any length, the position of the drive pulley and driven pulley, the position of the tensioner pulley and its support base (for three-pulley testing machines), and the position of the reversed bending tensioner pulley (for four-pulley testing machines) shall be adjustable, so as to enable the arrangement of the pulley and to satisfy the requirements of belts of any length.

In order to ensure the tension load can be correctly applied to the belt, while meeting the belt extension, the tension applied on the support base (where necessary) and its bearing device can slide freely along the tension line.

For four-pulley testing machines under this condition, the tension line shall be located on the same plane where the centres of the pulleys are; divide the angle formed by the V-ribbed belt at the tensioner pulley and at the reverse bending tensioner pulley.

For three-pulley testing machines under this condition, the tension line shall be located on the same plane where the centres of the pulleys are, and divide the angle formed by the V-ribbed belt at the tension pulley.

For two-pulley testing machines, one of the pulleys (drive pulley or driven pulley) shall be movable in order that the testing machine can test V belt with a length of 800mm. There shall be a fastening device on the testing machine, which shall be able to fix the position of the movable pulley when the belt is bearing the specified tension force. In order to ensure the specified tension force can be applied to the belt correctly, while meeting the belt extension, the tension line shall pass through the centre of the driver pulley and the centre of the pulley shaft of the driven pulley, and shall be located on the same plane as the centres of the two pulleys (see Figure A.3).

A.2.2 Test pulley

The arithmetic mean value of the surface-roughness R (see GB/T 1135) of the groove sides of the test pulley shall not exceed 0.8μm. The dimension requirements of the test pulley are shown in Figure A.4 and Table A.2.

A.3 Laboratory conditions

The ambient temperature of the test shall be:

a) the temperature in the laboratory shall be 18°C-32°C. During the test, the surroundings of the test transmission equipment shall not have any other airflow except from the equipment itself;

b) the temperature inside of the thermostat shall be controlled at 85°C ±5°C.

Note 1: The radial run-out value and axial run-out value (Total Indicated Run-out) shall not exceed 0.25 mm, and both run-outs shall be determined by measuring the radial run out of eccentricity of the ball which has a good contact with the pulley groove by the spring pressure when the pulley is in operation.

2. The surface roughness of the pulley groove with Ra as the index shall be smaller than 0.8μm. As under such situation, the Ra is a main parameter of the test pulley, so the value of Ra is determined as 0.87. See GB/T 11375 for the definition of Ra and its measuring method.

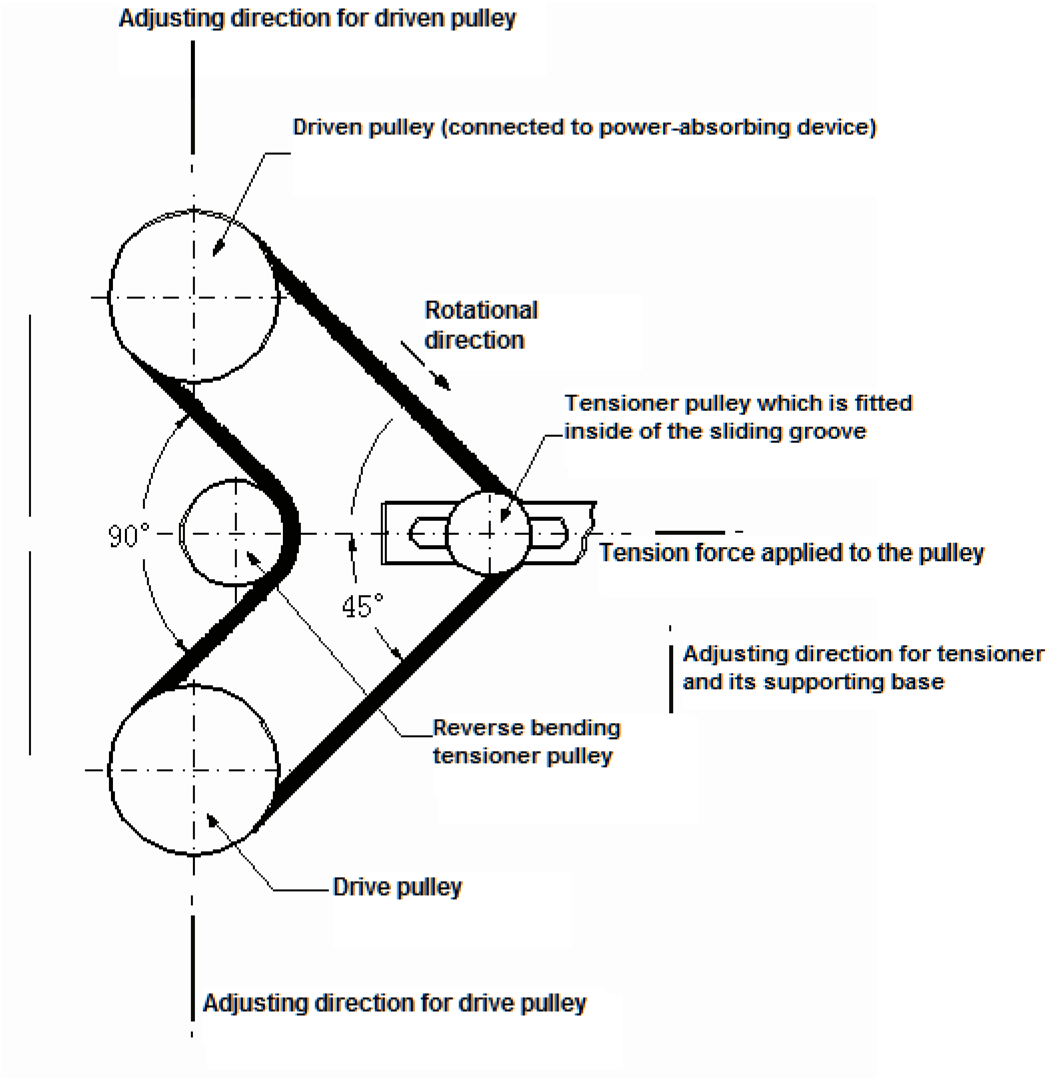


Figure A.1 Arrangement of four-pulley testing machine

Note: the angle formed by the plane which the fitted belt is on and the plane which is determined by the centres of the pulleys shall be adjusted to ±15'.

The value 45^{o} shall be the test beginning of said angle, which can change due to the retension of the belt during the test process

A.4 Test methods

A.4.1 Test conditions

The rotational speed of the drive pulley shall be 4900r/minute; the limit deviation of the rotational speed shall be ±2%. The recommended transmission power (use 3 ribs as reference) for three-pulley

or four-pulley fatigue testing machines shall be 8kW, and the tension force shall be 680 ±30N. In respect to V-ribbed belts with 3-5 ribs; if any special requirements are requested by the buyer, they can be agreed upon between the manufacturer and the buyer. The specific test conditions shall be determined by the following formula.

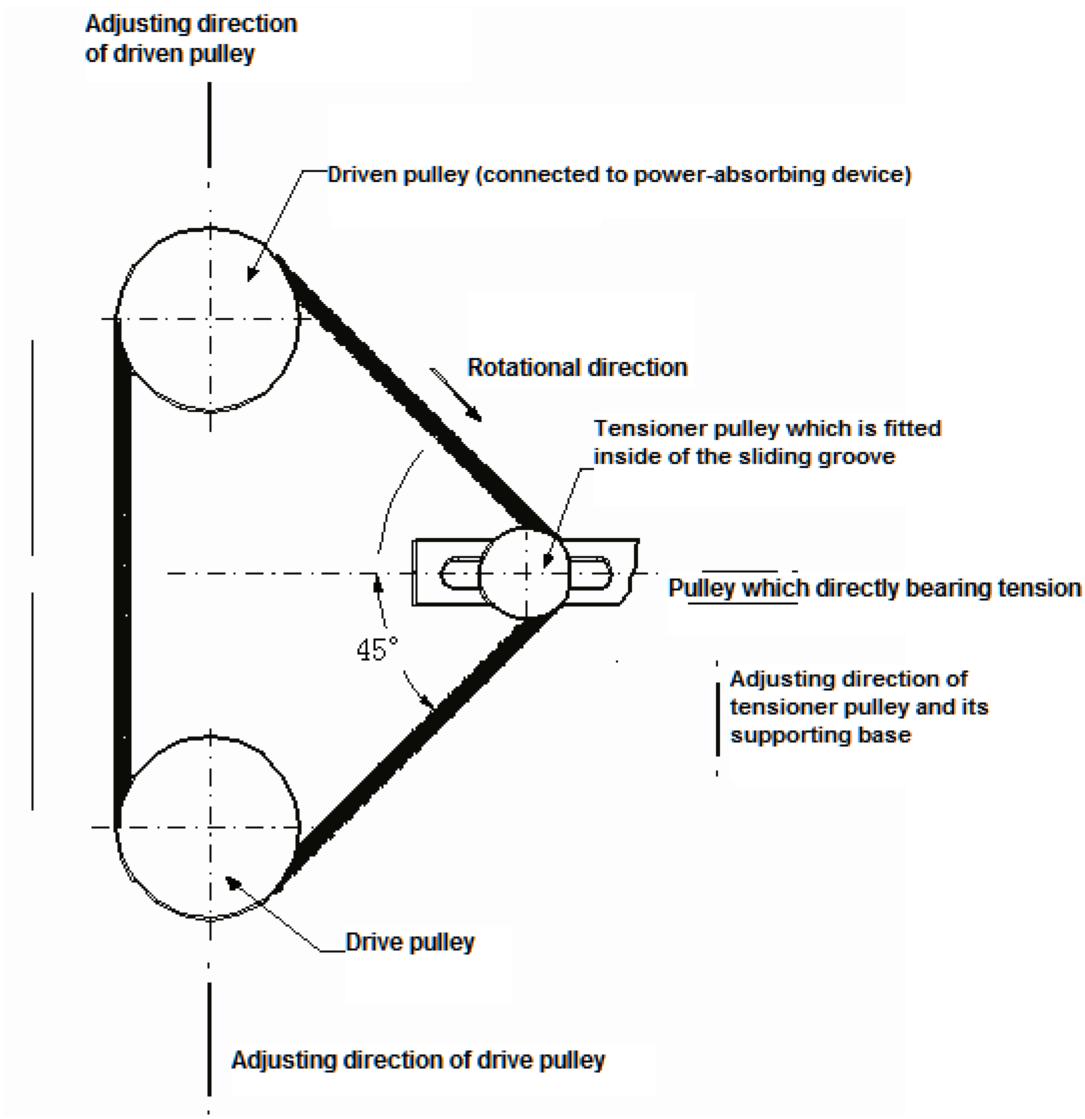
Use the rotational speed of the drive pulley to calculate the torque. The torque shall be constant when it does not have to make up the speed loss of the driven pulley caused by the slippage of the belt.

The torque M shall be determined by the following formula:

$$M = \frac{P_s \times 9545}{V} \quad \cdots\cdots (3)$$

Where: M – the torque, unit is Newton.meter (Mm);

P_s – the specified transmission power, unit is kilowatts (kW);



Note: the angle formed by the plane which the fitted belt is on and the plane which is determined by the centres of the pulleys shall be adjusted to ±15'.
The value 45^{o} shall be the test beginning of the said angle, which can change due to the retension of the belt during the test process.

Figure A.2 Arrangement of three-pulley testing machine

V – Rotational speed of the drive pulley, unit is rotation per minute (r/min).
The test equipment shall be correctly maintained; the additional load caused by the bearing loss, lubrication etc. shall be kept to a minimum as far as possible.

A.4.2 Procedures

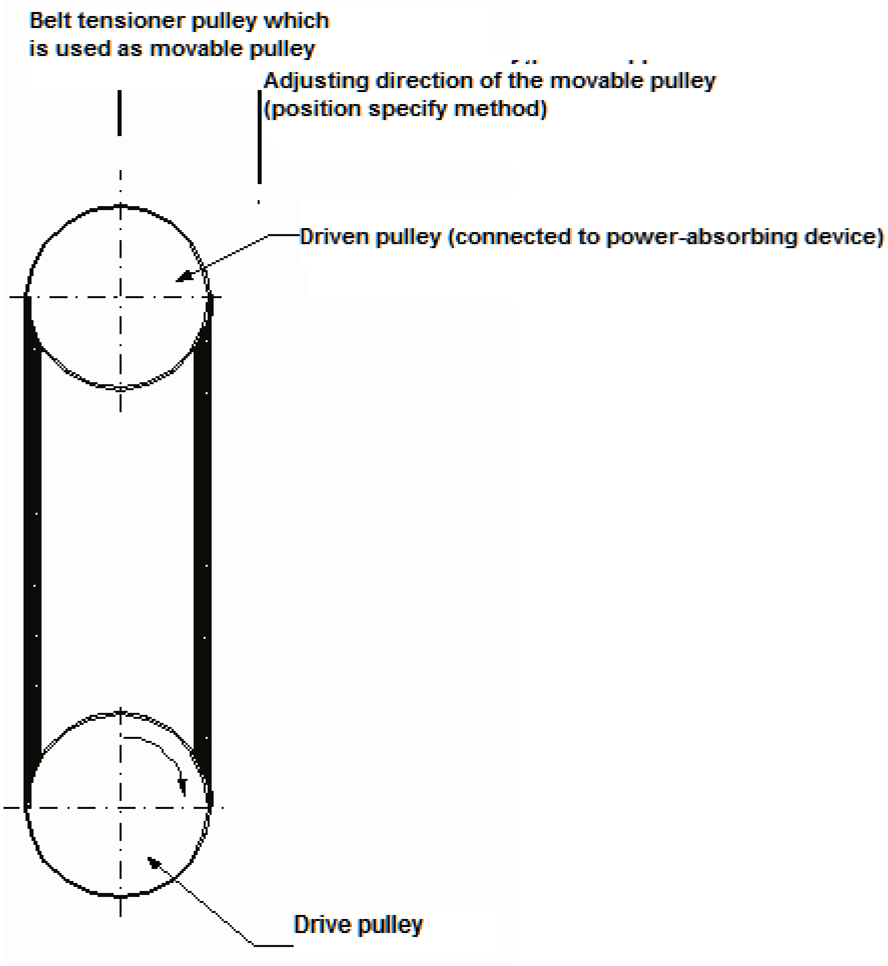
A.4.2.1 Test preparations

A.4.2.1.1 Preparation of three-pulley or four-pulley testing machines

Method A

Wrap the belt onto the pulley and apply the test tension force to the tensioner pulley (see A.4.1). Start the testing machine where the supporting base of the tensioner pulley can move freely in the sliding groove, and enable the transmission equipment to meet the rotational speed (see A.4.1). Apply the specified load to the driven pulley as quickly as possible, making the power-absorbing device absorb the specified power.

When the operation of the transmission equipment has been kept in this condition for 5min ±15s (exclusive of starting time and braking time), stop the testing machine for at least 10 minutes. Next, use hands to rotate the pulley, rotating the belt for a few cycles, then immediately fix the position of the supporting base of the tensioner pulley.



Note: the angle formed by the plane which the fitted belt is on and the plane which is determined by the centres of the pulleys shall be adjusted to ±15'.

Figure A.3 Arrangement of two-pulley testing machine

Method B:

Wrap the belt onto the pulley and apply the test tension force to the tensioner pulley (see A.4.1), making the supporting base of the tensioner pulley move freely in the sliding groove, then use hands to rotate the pulley, rotating the belt for a few cycles, then fix the position of the supporting base of the tension pulley as quickly as possible.

Note: if a new pulley is selected for this test, then a non-testing belt should be used to carry out run-in for at least 48 hours in accordance with the test procedures, after which the fatigue test can be conducted.

A.4.2.1.2 Preparation of two-pulley testing machines

Carry out preparation in accordance with the procedure specified in A.4.2.1.1, however, the supporting base of the tensioner pulley should be changed to the supporting base of the movable pulley.

Table A.2 Dimensions of testing pulley

Item	Symbol	Value	Limit deviation
Groove number		3	
Groove spacing	e	3.56	± 0.05[a)b)]
Groove angle[c)]		40^o	± 0^{o}30'
arc radius[d)] of groove root	r_b	0.5	0 -0.05
arc radius[e)] of groove top	r_t	0.25	+0.10 0
Effective diameters of drive pulley and driven pulley[e)]	d_{e1}	121	± 0.02
Effective diameter of tensioner pulley[5)]	d_{e2}	45 or 55[f)]	± 0.2
Effective diameters of drive pulley and driven pulley[g)]	d_{e2}	63	± 0.2
External diameter of reverse bending tensioner pulley	d_{r3}	60 or 76[)]	± 0.2
Pitch diameter[10)]	d_p	$d_p = d_e + 2b_e$	-
Effective line differential	b_e	2	Nominal value
Spacing between the paralleled circumscribed planes of the measuring ball or column[11)]	K	$K = d_e + 2x$	-
Spacing between the external surface of the pulley to the circumscribed plane of the measuring ball or column	2x	0.99	-
Diameter of the measuring ball or column	d_B	2.5	± 0.01
Spacing between the pulley surface and the centreline of the groove	f	>2.5	-

a – the distance deviation between the symmetry axis of two adjacent grooves.
b - the cumulative departure of the overall sum of e-value for one pulley shall not be greater than ± 0.3mm.
c – the angle between the symmetry axis of the groove and the axis shall be 90^o + 0.5^o.
d – In this standard, the limit deviation of rb and rc are specified (there is no such specification in ISO9981), because they are important parameters for the testing pulley.

e – only applies to three-pulley or four-pulley testing machines.
f – 45mm is the minimum recommended value set in ISO9981; for this reason, this value can be used for the tests, and 55mm is the best recommended value for actual designing.
g – only applies to two-pulley testing machines.
h – only applies to four-pulley testing machines.
i – shall not conduct specified standardisation on the smallest diameter for reverse bending pulley. 60 mm is only used during testing and cannot be used for actual transmission equipment.
j – the actual pitch diameter when the belt is matched with the pulley shall be slightly bigger than the effective diameter of the pulley; the exact value can only be determined when the selected belt is fitted onto the pulley and is in operation, the approximately calculated transmission ratio can be considered as the nominal value (b_e = 2mm) of the effective line differential. When more accuracy is required, the belt manufacturer should be consulted. See GB/T 17516.2-1998 for the calculation formula.
k – The differential value of the diameters measured on the grooves of a pulley shall not be greater than 0.15mm. The spacing comparison of the circumscribed planes of the measuring ball or column can be used to indicate the diameter comparison of each groove.

A.4.2.2 Tests

After the inside temperature of the thermostat has reached 85°C ±5°C, start (in A shall be 'restart') the testing machine, enable the transmission equipment to meet the specified rotational speed. Apply the test load to the driven pulley and determine the slippage rate of the belt between the drive pulley and driven pulley.

Allow the testing machine to continuously operate under this condition until the belt loses efficiency or the incremental of the slippage rate (g) reaches 4%.

The incremental of the slippage rate (g) shall be represented by percentage and can be determined by the following formula:

$$g = (i_o - i_t) \times 100$$

Where:

$i_o = n_o/N_o$

$i_t = n_t/N_t$

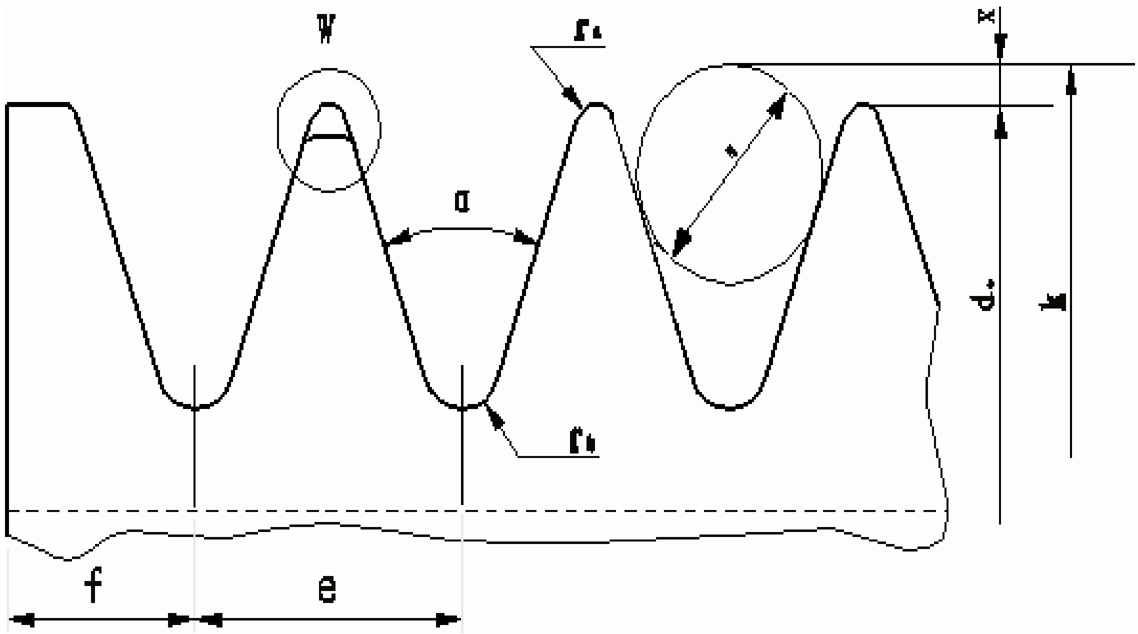
n_o – the initial rotational speed of the driven pulley;

n_t – the rotational speed of the driven pulley at the end of the test;

N_o – the initial rotational speed of the drive pulley;

N_t – the rotational speed of the drive pulley at the end of the test.

All rotational speeds in this formula shall be rotational speeds under the test load.



Enlargement of Part W:

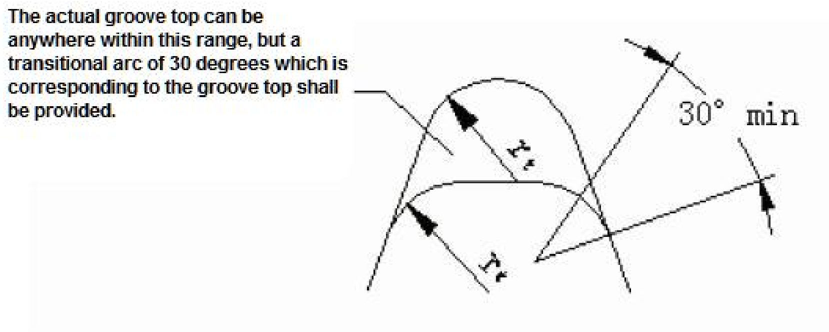


Diagram A.4 Pulley cross-section view

A.4.2.3 Retension of belt

Before the belt loses its efficiency, when the incremental of the slippage rate reaches 4% immediately stop the testing machine for at least 20 minutes (cool to 15°C ~ 35°C), then loosen the supporting base of the tensioner pulley (only for three-pulley or four-pulley testing machines). Apply the test tension to the belt, use hands to rotate the pulley for 2 ~ 3 cycles, fix the position of the supporting base of the tensioner pulley again in accordance with A.4.2.1, and repeat the test procedure as set out in A.4.2.2.

A.4.2.4 Use this as the starting time of the fatigue life span, operate for 10 hours then determine the slippage rate every two hours. Stop the machine to check the state of the damage done to the belt, and then re-start the testing machine.

A.4.2.5 When the slippage rate reaches 4% for the third time, or when the belt is damaged as shown in Figure 4, terminate the test and record the fatigue life span of the belt.

A.5 Test report

The test report shall contain at least the following information:

a) indication that the tests were conducted in accordance with this standard;
b) the mark of the test belt;
c) the model of the testing machine used (where necessary, the effective diameter of the tensioner pulley or the external diameter of the reverse bending tensioner pulley shall be indicated);
d) the test preparation method used (method A or method B);
e) the operating time which meets the prescribed requirement (hour as the unit);
f) the transmission power and the rib numbers of the v-ribbed belt;
g) retension times and operating hours of each retension (hour as the unit);
h) the average ambient temperature during the test period;
i) the date of the test.